CHROMOSOME NUMBERS IN SOME BRAZILIAN COMPOSITAE

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During the past two decades research on plant chromosome numbers has been increasing at an ever accelerating pace. However as recently as 1963 Heywood and Davis estimated that chromosome numbers had been determined for less than 10% of all species of flowering plants. Even this low estimate gives a somewhat distorted picture of the actual situation since a relatively large portion of northern hemisphere species have been counted whereas there has been a considerable lag in the determination of chromosome numbers of southern hemisphere species.

The Compositae is a convenient and interesting family to investigate cytologically because of its ubiquitous nature and often unsettled taxonomy. The value of chromosome numbers in making taxonomic evaluations and evolutionary interpretations has often been discussed, the most complete recent reference being Heywood and Davis (1963). Also, the fact that the Compositae of North and Central America have been subjected to rather extensive cytological investigation makes further knowledge of South American species especially desirable as it will tend to fill gaps in our knowledge thereby making possible comparisons between taxa occurring in these different areas.

Prior to the present paper, only a single paper (Turner and Irwin, 1960) reporting counts for 14 species had been devoted specifically to chromosome numbers in the Brazilian Compositae. In the present paper counts are reported for 82 individuals representing 68 species distributed amongst 39 genera and 8 tribes. First reports are presented for 6 genera.

MATERIALS AND METHODS

The material examined was collected in the states of São Paulo, Rio de Janeiro and Minas Gerais. A complete set of voucher specimens has been deposited in the herbarium

of the Instituto de Botânica of São Paulo and a nearly complete second set will be deposited in the herbarium of Indiana University.

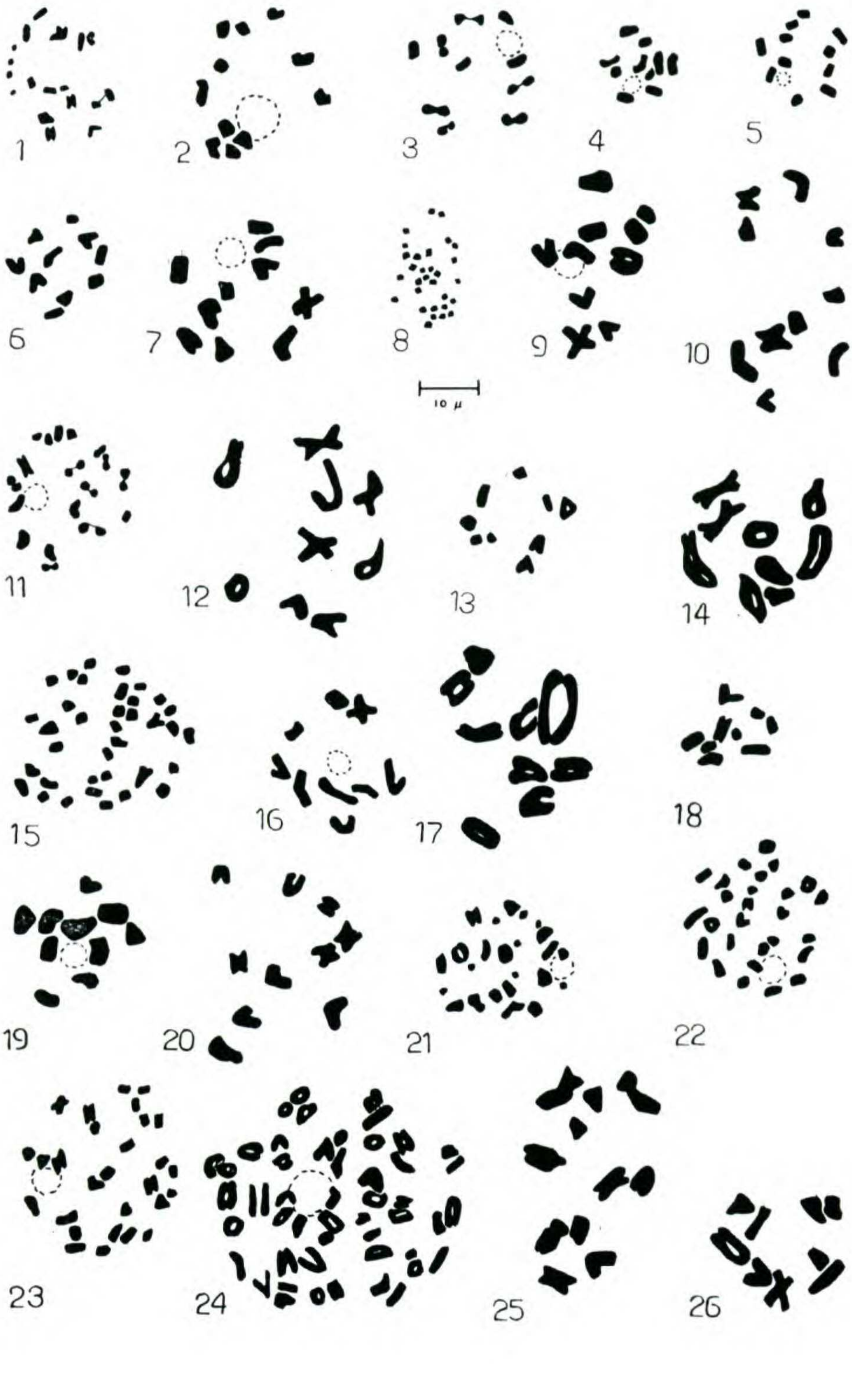
The taxonomic determinations are those of the author, the primary reference being Baker's treatment of the Compositae in Martius' Flora Brasiliensis (1884). Because of the antiquity of this treatment, more recent monographs were consulted whenever possible. In the vast majority of cases material for comparison was available in the herbarium of the Instituto de Botânica of São Paulo.

The buds were fixed in the field in a solution of 6 parts ethyl alcohol: 2 parts chloroform: 2 parts propionic acid and were kept in the fixative for at least 24 hours prior to examination. Immature florets were placed on a slide in a drop of acetocarmine and squashed with a scalpel blade; excess floral tissue was removed and a cover slip applied. The slide was next warmed over an alcohol lamp, inverted on a piece of filter paper and pressed with a steady pressure applied by the thumb. Camera lucida drawings of the chromosomes were made and in many cases slides were made permanent with Hoyer's mounting medium. Selected camera lucida drawings are presented in figures 1-26. Table 1 summarizes the results obtained.

DISCUSSION

VERNONIEAE — The count of $n = 11$ for *Elephantopus mollis* is in agreement with an earler report for this species (Chuang *et al.* in Cave, 1964) from Taiwan. *Orthopappus angustifolius* represents a montotypic genus and the count of $n = 11$ is the initial report of its chromosome number. This species was originally described in the genus *Elephantopus*; however Gleason (1906) considered the pappus characters of this species sufficiently distinct from species of *Elephantopus* to warrant the erection of the monotypic genus *Orthopappus*. The few counts available for *Elephantopus* indicate these two genera to be similar in having $x = 11$. The four species of *Vernonia* reported are in agreement with the majority of previous counts reported for that genus in that they are based on $x = 9$; however each is polyploid.

EUPATORIEAE — *Adenostemma brasilianum* has previously been reported to have $n = 5$ (Turner and Irwin, 1960); however counts reported in the present paper from two populations are $n = 10$. It therefore seems probable either that more than one taxon is involved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in these conflicting reports or that *A. brasilianum* has naturally occurring tetraploid populations. The count of $n = 10$ for *Alomia fastigata* constitutes the second report for that genus. *Alomia microcarpa* (Benth.) Rob. has previously been reported also as having $n = 10$ (Turner and King in Cave, 1965). Three species of *Stevia*, each having $n = 11$, are reported. In addition to counts of $n = 11$, counts of $n = 12$ and 17 have been reported for North American species of *Stevia* (Powell and Turner in Cave, 1964). The count of $n = 10$ for *Trichogonia gardneri* represents the first report for this South American genus of about 25 species, the majority of which are Brazilian. *Symphyopappus cuneatus* and *S. polystachyus*, both $n = 10$, are the first members of that genus to be reported. Robinson (1919) expressed the opinion that *Symphyopappus* is a genus of doubtful value as the characters used to separate it from *Eupatorium* tend to break down. The two species of *Symphyopappus* reported here are similar cytologically to most species of *Eupatorium* thus far reported in having $x = 10$. In the present paper ten species of *Eupatorium*, all based on $x = 10$, are reported. Four species of *Mikania* are reported, each having $n = 18$ or approximately 18. As the bivalents of these species tended to fall apart rather easily, presumably due to low chiasma frequency, exact counts were difficult to secure. The report of $n =$ c. 18 for *Kanimia strobilifera* constitutes the first report for that genus. Hoffmann (1894) placed *Mikania* in the subtribe *Ageratinae* and *Kanimia* in the subtribe *Adenostylinae*. This treatment tends to obscure the evidently quite close affinity of these two genera whose only strong distinguishing character appears to be that the achenes of *Mikania* are 5-ribbed whereas those of *Kanimia* are 8-10-ribbed.

ASTEREAE — The report of $n = 9$ for *Inulopsis scaposa* is the first for this Brazilian genus of perhaps two species. This species was

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FIGURES

1. *Vernonia polyanthes* $n = 18$ 2. *Orthopappus angustifolius* $n = 11$ 3. *Adenostemma brasilianum* $n = 10$ 4. *Alomia fastigata* $n = 10$ 5. *Stevia veronicae* $n = 11$ 6. *Eupatorium intermedium* $n = 10$ 7. *Eupatorium velutinum* $n = 10$ 8. *Eupatorium ballotaefolium* $n = 30$ 9. *Symphyopappus cuneatus* $n = 10$ 10. *Symphyopappus polystachyus* $n = 10$ 11. *Kanimia strobilifera* $n =$ c. 18 12. *Inulopsis scaposa* $n = 9$ 13. *Solidago chilensis* $n = 9$ 14. *Podocoma hirsuta* $n = 9$ 15. *Conyza chilensis* $n = 36$ 16. *Baccharidastrum nottobelidiastrum* $n = 9$ 17. *Baccharis helichrysoides* $n = 9$ 18. *Baccharis oxyodonta* $n = 9$ 19. *Pluchea suaveolens* $n = 10$ 20. *Pterocaulon alopecuroides* $n = 10$ 21. *Clibadium armani* $n = 24$ 22. *Jaegeria hirta* $n = 27$ 23. *Wedelia pilosa* $n = 28$ 24. *Senecio adamantinus* $n = 50$ 25. *Trixis pinnatifida* $n = 11$ 26. *Hieracium commersonii* $n = 9$

included by Baker (1884) in the genus *Leucopsis*, but served as the type species of the genus *Inulopsis* which was erected by Hoffman (1894). Since no chromosome numbers have yet been reported for species undisputedly considered to be *Leucopsis*, no comparison of chromosome numbers between these two genera is possible. The count of $n = 9$ for *Solidago chilensis* concurs with a previous report for this species (Beaudry and Chabot, 1959). *Aster squammatus* has been reported as $n = 10$ (Solbrig *et al*, 1964). In the present paper an approximate count of $n = 9$ or 10 is given. The report of $n = 9$ for *Podocoma hirsuta* is the first report for this genus of about 12 species, the majority of which are South American but two of which are Australian. *Conyza chilensis* has been reported as having $n = 36$ (Solbrig *et al*, 1964) and $n = 36$-38 (Turner and King in Cave, 1965); the count given in the present paper is $n = 36$. The genus *Baccharidastrum* was erected by Cabrera (1937) who distinguished it from *Baccharis* on the basis of the hermaphroditic heads of the former. The count of $n = 9$ for *Baccharidastrum notobellidiastrum* (= *Gonyza notobellidiastrum* Griseb.) is the initial report for the genus. The three species of *Baccharis* reported brings to about 23 the number of species counted in this genus of about 350 species. All reports to date are based on $x = 9$ with polyploidy infrequent.

INULEAE — The report of $n = 10$ for *Pluchea suaveolens* is in agreement with previous reports of other species of this genus. The count of $n = 10$ for *Pterocaulon alopecuroides* is the second report for the genus and the first for a South American species. Turner and Flyer (1966) have reported *P. undulatum* (Walt.) Mohr from Florida also to have $n = 10$.

HELLIANTHEAE — The only previous report for the genus *Clibadium* is for *C. surinamense* L. which is given as $n = 16$ (Turner and King in Cave, 1965). In the present paper *C. armani* is reported to have $n = 24$ which would indicate *Clibadium* to be based on $x = 8$. The haploid complement of *C. armani* revealed a dimorphism in regard to size with 16 larger and 8 decidedly smaller chromosomes (fig. 21). The possibility that the 8 smaller chromosomes are B chromosomes can not as yet be excluded. *Acanthospermum australe* has been reported to have $n = 10$ (Carlquist in Cave, 1959); however the count given in the present paper is $n = 11$. *Acanthospermum hispidum*, the only other member of the genus thus far reported, also has $n = 11$ (Miège in Cave, 1964). *Parthenium hysterophorous* has been reported to have $n = 18$ (Thombre in Cave, 1960), $n = 17$ (DeJong and Longpre, 1963) and $2n = 34$ and 35 (Rollins in Cave, 1963). The count reported in this paper is $n = 17$. The report of $n = 18$ for *Ambrosia polystachya* agrees with a previous report for this species (Turner and Irwin, 1960). *Jaegeria hirta* has been re-

ported three times previously, each as having $n = 18$ (Turner *et al*, 1962; Turner and King in Cave, 1965; Turner and Flyer, 1966). In the present study individuals from two populations were examined, one clearly showing $n = 27$ and the other $n =$ c. 27. The conflicting reports for *J. hirta* suggest either that more than a single taxon is involved or the existence of naturally occurring triploid populations. Species of *Wedelia* have now been reported to have $n = 11$, 12, 15, 20, 22, 23, 25, 28, 29 ± 1, and c. 36 thus revealing an aneuploid series to exist in the genus. Counts of $n = 16$ and 19 are reported for two species of *Calea*. In addition to counts of $n = 16$ and 19, counts of $n =$ c. 17 and 18 have been reported for North American species (Turner *et al*, 1961; Turner *et al*, 1962).

SENECIONEAE — The count of $n = 10$ for *Emilia coccinea* is in agreement with a previous report for this species (Baldwin, 1946) and the count of $n = 20$ for *Erechtites hieracifolium* concurs with previous reports for this species (Arano in Cave, 1963; Turner and King in Cave, 1965). The counts reported for three species of *Senecio* are consistent with the majority of previous reports for the genus in that they are based on $x = 10$.

MUTISIEAE — Counts of $n = 24$ for *Chaptalia nutans* and *C. integerrima* confirm earlier reports for these species (Turner, 1959; Baldwin and Speese, 1947). Species of *Perezia* have previously been reported to have $n = 8$ (Heiser, 1963) and $n = 12$ (Diers in Cave, 1961). The report of $n = 4$ for *P. cubataensis* establishes that $x = 4$ in *Perezia*. The report of $n = 27$ for *Trixis divaricata* is consistent with previous reports for the genus. However the report of $n = 11$ for *Trixis pinnatifida* indicates *Trixis* to be dibasic with $x = 11$ and 27.

CICHOREAE — Reports of $n = 4$ confirms earlier reports for *Hypochaeris brasiliensis* (Stebbins, 1953) and *H. radicata* (Heiser, 1963; Turner and King in Cave, 1965). *Hypochaeris gardneri*, $n = 5$, is reported for the first time.

SUMMARY

Chromosome numbers are reported for 68 species of Brazilian Compositae, initial reports being made for six genera: *Baccharidastrum*, *Inulopsis*, *Kanimia*, *Podocoma*, *Symphyopappus* and *Trichogonia*. *Adenostemma brasilianum*, previously reported to have $n = 5$, is reported to have $n = 10$ and *Jaegeria hirta*, previously reported to have $n = 18$, is reported to have $n = 27$. It is suggested either that more than a single taxon is involved in these conflicting reports or that naturally occurring polyploid populations

exist. It is established that $x = 4$ in *Perezia* and *Trixis* is indicated to be dibasic with $x = 11$ and 27.

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Table 1. List of material examined for chromosome number

Species	$n =$	Locality
VERNONIEAE		
Elephantopus mollis H. B. K.	11	State of São Paulo: Parque do Estado, São Paulo. *190*[2]
Orthopappus angustifolius (Sw.) Gleason	11	State of São Paulo; Parque do Estado, São Paulo. *191*
Vernonia diffusa Less.	c. 18	State of São Paulo: Parque do Estado, São Paulo. *429*
Vernonia polyanthes Less.	18	State of São Paulo: Parque do Estado, São Paulo. *416*
Vernonia scorpioides Pers.	28±1	State of São Paulo: Parque do Estado, São Paulo. *267*
Vernonia cognata Less.	26-27	State of São Paulo: Parque do Estado, São Paulo. *202*
EUPATORIEAE		
Adenostemma brasilianum Cass.	10	State of Rio de Janeiro: Maromba, Parque Nacional de Itatiaia. *369*
Adenostemma brasilianum Cass.	10	State of São Paulo: 13 km SW of Ubatuba. *206*
Ageratum conyzoides L.	20	State of São Paulo: 25 km NE of São Paulo. *295*
Ageratum conyzoides L.	20	State of São Paulo: Parque do Estado, São Paulo. *204*
Alomia fastigiata (Gardn.) Benth.	10	State of São Paulo: Parque do Estado, São Paulo. *374*

[2]Collection numbers are those of the author.

Eupatorium ballotaefolium H. B. K.	30	State of São Paulo: Parque do Estado, São Paulo. *304*
Eupatorium callilepis Sch. Bip.	20	State of São Paulo: Parque do Estado, São Paulo. *428*
Eupatorium congestum H. & A.	20	State of São Paulo: Parque do Estado, São Paulo. *338*
Eupatorium intermedium DC.	10	State of São Paulo: Parque do Estado, São Paulo. *209, 259*
Eupatorium laetevirens H. & A.	10	State of Minas Gerais: Brejo de Lapa, Parque Nacional de Itatiaia. *374*
Eupatorium lanigerum H. & A.	30	State of São Paulo; Parque do Estado, São Paulo. *261*
Eupatorium macrophyllum L.	10	State of São Paulo: Midway between Bertioga and Maresias. *245*
Eupatorium orbiculatum DC.	10	State of São Paulo: 5 km E of São José dos Campos. *282*
Eupatorium pallescens DC.	10	State of Rio de Janeiro: Maromba, Parque Nacional de Itatiaia. *355*
Eupatorium pallescens DC.	10	State of São Paulo: 8-10 km ESE of Campos do Jordão. *346*
Eupatorium vellutinum Gardn.	10	State of São Paulo: 8 km S of Campos do Jordão. *306*
Eupatorium vellutinum Gardn.	10	State of São Paulo: Parque do Estado, São Paulo. *258*
Kanimia strobilifera Gardn.	c. 18	State of São Paulo: c. 5 km E of Itirapina. *260*
Mikania campanulata Gardn.	17-18	State of São Paulo: Parque do Estado, São Paulo. *426*
Mikania capricorni Robinson	17-18	State of São Paulo: Parque do Estado, São Paulo. *427*

Mikania conferta Gardn.	18	State of São Paulo: 8 km S of Campos do Jordão. *181*
Mikania pachylepis Sch. Bip.	18±1	State of São Paulo: Parque do Estado, São Paulo. *291*
Stevia decussata Baker	11	State of Rio de Janeiro: Rebouças, Parque Nacional de Itatiaia. *379*
Stevia conmixta Robinson	11	State of São Paulo: Parque do Estado, São Paulo. *430*
Stevia veronicae DC.	11	State of São Paulo: 8-10 km ESE of Campos do Jordão. *334*
Symphyopappus cuneatus Sch. Bip.	10	State of São Paulo: Parque do Estado, São Paulo. *192*
Symphyopappus polystachyus Baker	10	State of São Paulo: Parque do Estado, São Paulo. *262*
Trichogonia gardneri Gray	10	State of São Paulo: Parque do Estado, São Paulo. *187*
ASTEREAE		
Aster squamatus (Spreng.) Hieron.	9-10	State of São Paulo: Parque do Estado, São Paulo. *314*
Baccharidastrum notobellidiastrum (griseb.) Herter	9	State of São Paulo: Parque do Estado, São Paulo. *196-197*
Baccharis genistelloides (Lam.) Pers.	9	State of São Paulo: Parque do Estado, São Paulo. *387*
Baccharis helichrysoides DC.	9	State of São Paulo: Parque do Estado, São Paulo. *193*
Baccharis helichrysoides DC.	9	State of Minas Gerais: Brejo de Lapa, Parque Nacional de Itatiaia. *376*
Baccharis oxyodonta DC.	9	State of São Paulo: Parque do Estado, São Paulo. *331*

Conyza chilensis Spreng.	36	State of São Paulo: Parque do Estado, São Paulo. *188*
Inulopsis scaposa (DC.) O. Hoffm.	9	State of São Paulo: 8-10 km ESE of Campos do Jordão. *312*
Inulopsis scaposa (DC.) Hoffm.	9	State of São Paulo: 5 km SE of Sao José dos Campos. *317*
Podocoma hirsuta Baker	9	State of São Paulo: Parque do Estado, São Paulo. *230*
Solidago chilensis Meyen.	9	State of São Paulo: Parque do Estado, São Paulo. *290*
INULEAE		
Pluchea suaveolens (Vell.) O. Ktze.	10	State of São Paulo: Parque do Estado, São Paulo. *194*
Pterocaulon alopecuroides (Lam.) DC.	10	State of São Paulo: Parque do Estado, São Paulo. *254*
HELIANTHEAE		
Acanthospermum australe (L.) O. Ktze.	11	State of São Paulo: Parque do Estado, São Paulo. *201*
Ambrosia polystachyus DC.	18	State of São Paulo: 5-8 km E of Amparo. *256*
Bidens segetum Mart. ex Colla	26±2	State of São Paulo: 8 km S of Campos do Jordão. *390*
Calea multipega H. Krasch	16	State of São Paulo: 15 km W of Itirapina. *302*
Calea pinnatifida Banks	19	State of São Paulo: Parque do Estado, São Paulo. *255*
Calea pinnatifida Banks	19	State of São Paulo: 5-8 km E of Amparo. *263*
Clibadium armani (Balbis) Sch. Bip.	24	State of São Paulo: Parque do Estado, São Paulo. *265*
Eclipta alba (L.) Hassk.	11	State of São Paulo: Parque do Estado, São Paulo. *210*

Eclipta alba (L.) Hassk.	11	State of São Paulo: Caraguatatuba State Park. *207*
Jaegeria hirta Less.	27	State of São Paulo: Parque do Estado, São Paulo. *203*
Jaegeria hirta Less.	c. 27	State of São Paulo: 8 km S of Campos do Jordão. *391*
Parthenium hysterophorous L.	17	State of São Paulo: Parque do Estado, São Paulo. *268*
Verbesina glabrata H. & A.	17	State of São Paulo: 13 km SW of Ubatuba. *298*
Verbesina glabrata H. & A.	17	State of São Paulo: Parque do Estado, São Paulo. *297*
Verbesina glabrata H. & A.	17	State of Rio de Janeiro: Rebouças, Parque Nacional de Itatiaia. *382*
Wedelia pilosa Baker	28	State of São Paulo: Parque do Estado, São Paulo. *396*
Wedelia subvelutina DC.	c. 36	State of São Paulo: c. 9 km SW São José dos Campos. *211*
SENECIONEAE		
Emilea coccinea (Sims.) Sweet.	10	State of São Paulo: 10 km NE of Pirassununga. *251*
Erechtites hieracifolium Rafin.	20	State of São Paulo: Parque do Estado, São Paulo. *527, 266*
Senecio adamantinus Bong.	50	State of São Paulo: 8-10 km ESE of Campos do Jordão. *179*
Senecio brasiliensis Less.	20	State of São Paulo: 8 km S of Campos do Jordão. *179*
Senecio erisithalifolius Sch. Bip.	20	State of São Paulo: 8-10 km ESE of Campos do Jordão. *305*
MUTISIEAE		
Chaptalia integerrima (Vell.) Burk.	24	State of São Paulo: Parque do Estado, São Paulo. *309*

Chaptalia nutans (L.) Polak.	24	State of São Paulo: Parque do Estado, São Paulo. *172*
Chaptalia mandoni (Sch. Bip.) Burk.	24	State of São Paulo: Parque do Estado, São Paulo. *285*
Perezia cubataensis Baker	4	State of São Paulo: Parque do Estado, São Paulo. *212*
Trixis divaricata (H. B. K.) Spreng.	27	State of São Paulo: Parque do Estado, São Paulo. *170*
Trixis pinnatifida Less.	11	State of São Paulo: 5 km E of Paranapiacaba. *389*, *397*
Hieracium commersonii Monnier	9	State of São Paulo: 8-10 km ESE of Campos do Jordão. *388*
Hypochaeris brasiliensis Griseb.	4	State of São Paulo: Parque do Estado, São Paulo. *189*
Hypochaeris gardneri Baker	5	State of São Paulo: 8-10 km ESE of Campos do Jordão. *299*, *332*
Hypochaeris radicata L.	4	State of São Paulo: Parque do Estado, São Paulo. *200*